

Complications of internally fixed femoral neck fractures

Femur boyun kırıklarında internal tespit sonrası komplikasyonlar

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BACKGROUND

Femoral neck fractures in young patients are the emergent injuries that require precise reduction and stable fixation. Despite all advances, nonunion and avascular necrosis (AVN) of the femoral head are the major complications necessitating salvage procedures. In this retrospective series, we evaluated the complications of internally fixed femoral neck fractures.

METHODS

This study consisted of 32 cases that had displaced femoral neck fractures. Although some of them admitted to hospital more than 8 hours after initial trauma, all underwent internal fixation as early as possible. All the fractures were reduced and fixed by closed reduction under fluoroscopy control. However, 5 cases needed open reduction. AVN was determined by using Ficat and Arlet criteria. Clinical evaluation was performed based on the scoring system described by Harris.

RESULTS

Mean follow-up period was 49±29 months (range 24-126). AVN of the femoral head was observed in 13 cases (40%). However, only 5 of them had unsatisfactory clinical results requiring salvage surgery as total hip replacement. Nonunion of fracture was seen in 5 cases. In the statistical analysis, a negative correlation was observed between the degree of AVN and clinical findings. We found no correlation between the duration of the preoperative period and late complications.

CONCLUSION

AVN is the most common complication of displaced femoral neck fractures. However, less than half of these cases require salvage procedures. Total hip replacement is the preferred treatment option for these cases.

Key Words: Avascular femoral head necrosis; femoral neck fracture; internal fixation; nonunion.

AMAÇ

Genç hastalarda femur boyun kırıkları kesin redüksiyon ve stabil tespiti gerektiren acil yaralanmalardır. Tüm gelişmelere rağmen femur başı avasküler nekrozu (AVN) ve kaynamama kurtarıcı ameliyatlar gerektiren en önemli komplikasyonlardır. Bu geriye dönük çalışmada, internal tespit yapılan femur boyun kırıklarının komplikasyonları değerlendirildi.

GEREÇ VE YÖNTEM

Deplase femur kırıklı 32 hasta çalışmaya dahil edildi. Bazı hastalar ilk yaralanmadan sekiz saat sonra hastanemize başvurmalarına rağmen en erken zamanda ameliyata alındılar. Açık redüksiyon gerektiren beş hasta dışında tüm olgulara kapalı redüksiyon ve tespit uygulandı. AVN, Ficat ve Arlet kriterlerine göre değerlendirildi. Klinik değerlendirme Harris tarafından tanımlanan puanlama sistemine göre yapıldı.

BULGULAR

Ortalama izlem süresi 49±29 aydı (dağılım 24-126). On üç olguda femur başı avasküler nekrozu belirlendi (%40); ancak yalnızca beş olguda yetersiz sonuca bağlı total kalça protezi uygulandı. Beş olguda da kaynamama saptandı. Yapılan istatistiksel analizde, AVN derecesi ve klinik puanlar arasında ters ilişki belirlendi. Ameliyata alınma süresi ile geç komplikasyonlar arasında ilişki saptanmadı.

SONUÇ

Deplase femur boyun kırıklarının en sık komplikasyonu AVN'dir. Ancak olguların yarısından azına kurtarıcı ameliyat gerekmiştir. Bu olgularda total kalça protezi uygun tedavi seçeneğidir.

Anahtar Sözcükler: Femur başı avasküler nekrozu; femur boyun kırığı; internal tespit; kaynamama.

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Femoral neck fractures are generally observed at two different peaks: first, due to high-energy trauma in relatively young adults, and second, due to low-energy trauma in osteoporotic elderly patients. Common treatment alternatives for these cases are internal fixation and arthroplasty options.^[1-3] Many factors including fracture type, patient age, and medical status affect the choice of treatment. Particularly, femoral neck fracture in young patients is an emergency condition and necessitates precise reduction and rigid internal fixation. Although new developments in operation techniques and implant technology have been achieved, avascular necrosis (AVN) of the femoral neck and nonunion are the most common and morbid complications.^[4-6] It has been reported that although not all the cases with AVN need arthroplasty procedures secondarily, nonunion is a morbid complication that usually requires salvage surgery.^[6,7]

In this retrospective study, we evaluated the complications and clinical results of the subjects treated by internal fixation.

MATERIALS AND METHODS

From January 1995 to December 2003, 304 patients with femoral neck fracture admitted to our clinic. Fifty-three cases were treated via internal fixation (15 dynamic hip screw, 38 only cannulated screw fixation). Of the remaining cases, 232 were treated via arthroplasty options due to older age, and 19 were treated conservatively due to poor medical condition or fracture type.

We lost 2 of 38 cases; therefore, we were able to evaluate 36 patients in this study treated by cannulated screw fixation. However, 4 of them had undisplaced fracture pattern as Garden II and were excluded.^[8] Therefore, this current series comprised 32 subjects. Twenty-five of the cases were male. The etiologies of fractures were as follows: 5 traffic accidents, 2 occupational injuries and 25 falls on the fracture site. Three cases had additional injuries as rib, radius and contralateral femur fractures.

Patients admitted to our hospital were transported to the operating room under emergency conditions after obtaining conventional radiographs. All cases were operated as soon as possible although some were admitted to the hospital more than 8 hours after trauma. All the operations were performed in the supine position. First, Leadbetter

maneuver was performed to reduce the fracture.^[9] Fractures that could be reduced were fixed by 6.5 mm cannulated screws under C armed fluoroscopy control. On the other hand, capsulotomy through lateral approach was performed to reduce and fix the fracture in 5 cases in whom closed reduction was not possible. All the cases were mobilized with crutches after removing urinary catheters and suction drains 48 hours postoperatively without weight-bearing. We used antibiotic prophylaxis and low molecular heparin for 2 and 7 days, respectively. Patients were encouraged regarding weight-bearing with respect to painless status and evidence of bony healing clinically and radiologically. Mean full weight-bearing time was 11 ± 1 weeks (range 9-13). Patients were followed up at 6-week intervals in the first half year and at 12-week intervals in the second in the outpatient clinic (Fig. 1a-c). To evaluate AVN, the radiographic criteria described by Ficat and Arlet were used.^[10] Clinical evaluation was performed according to Harris Hip Scoring (HHS) criteria as 90 to 100 points: excellent, 80 to 90: good, 70 to 80: fair, and below 70: poor.^[11] Fracture classification was performed using the criteria described by Garden.^[8] Statistical analysis with Spearman correlation test was performed using SPSS for Windows program.

RESULTS

Mean follow-up period was 49 ± 29 months (range 24-126). The average age of cases was 44.4 ± 13 years (range 14-60). According to Garden classification, there were 19 type III and 13 type IV fractures. The average interval from injury to operation was 18 ± 22 hours (range 2-84).

Superficial wound infection in 1 case and urinary tract infection in 3 cases were early complications. They were treated with oral antibiotics. In 3 cases, we observed reduction loss during outpatient clinic follow-ups in the early period (9%). One of them fell on his operated side despite warnings. These cases underwent revision as re-reduction and re-fixation. One case healed satisfactorily, but 2 did not, requiring total hip replacement procedure later due to nonunion. During the follow-up period, nonunion in another 3 cases was observed. Total hip arthroplasty was performed for these 5 cases due to nonunion.

With respect to late complications, AVN was ob-

served in 13 patients (40%). Five of these cases had unsatisfactory clinical results and required total hip arthroplasty. There were 10 required salvage procedures overall, for an incidence of 31%.

We determined a negative correlation between the degree of AVN and clinical findings at the last follow-up ($r = -0.46$, $p = 0.007$). The limb lengths of both extremities at the last follow-up were measured, and we found a mean 2 ± 6.5 mm length discrepancy as shortening (range $+15$ - $[-25]$).

The effect of the interval from initial trauma to operation on nonunion and AVN was analyzed. In this statistical analysis, we found $r = -0.089$, $p = 0.62$.

According to criteria described by Harris, there were 22 satisfactory (69%) and 10 unsatisfactory (31%) clinical results. In the satisfaction group, 14 cases had excellent and 8 cases had good results. In the unsatisfactory group, 5 cases suffered from nonunion and the other 5 from AVN of the femoral head, and all underwent total hip arthroplasty procedures. At the last follow-up, all were able to maintain daily activities.

DISCUSSION

The choice of intervention for femoral neck fractures depends especially on the patient's age. In elderly patients, hip arthroplasty is the first alterna-

tive due to its facilitating early weight-bearing, although it carries higher mortality rates. However, patients below 60, suffering from high-energy trauma such as traffic and occupational accidents or sports injuries, are usually treated via internal fixation. It was reported that early internal fixation is the gold standard for relatively young cases.^[12] In addition, some authors have claimed that femoral neck fracture in young patients should be considered as vascular injury. In this case, intervention should comprise prompt reduction of fracture and early internal fixation under emergency conditions.^[5,12-14]

The most important complication of femoral neck fractures is AVN.^[6,15,16] Calandruccio and Anderson performed autoradiographs of 113 patients who had intracapsular fracture and reported that 78% of fractures were partially or completely avascular.^[17] AVN occurs especially in displaced fractures rather than undisplaced fractures. In the literature, the reported rates of AVN of the femoral neck are between 10-39%.^[6,13,16,18] It was reported that the functionality of the cases who had AVN was not so poor as to require salvage surgery, although all these cases had clear radiologic evidence of AVN.^[12] Unlike in fracture instability or nonunion, clinical symptoms of AVN are variable depending on the stage and patient activities. In our

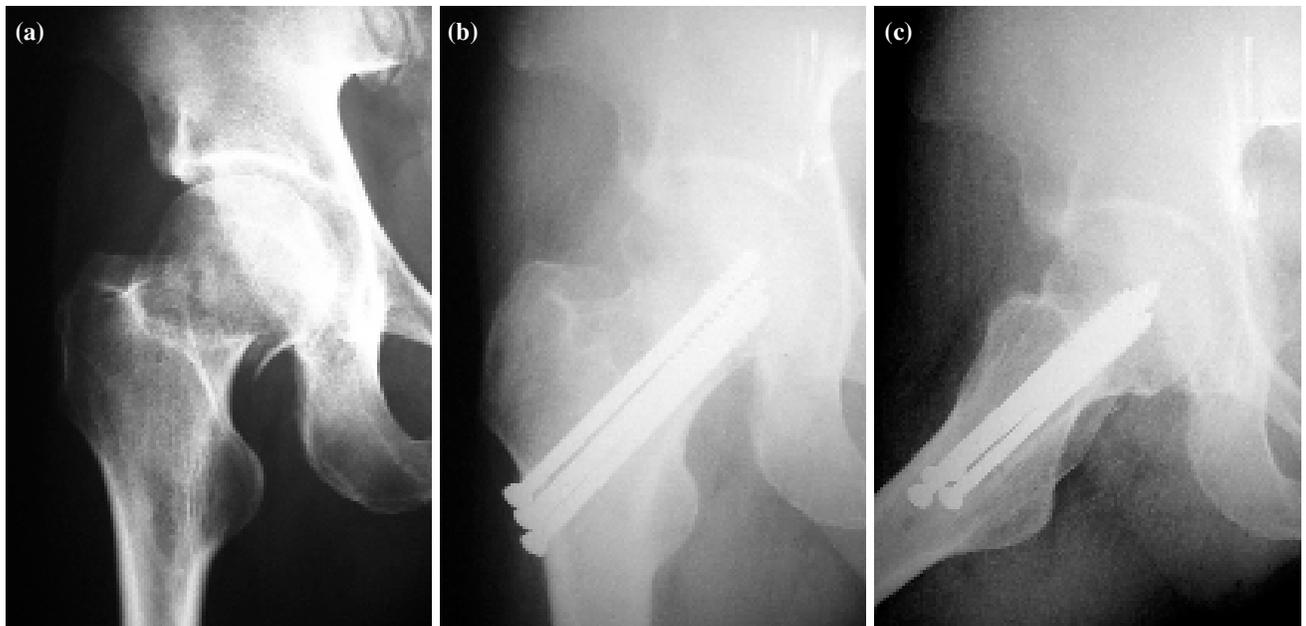


Fig. 1. (a) M.A.G., 56 years, male, preoperative view. (b) Postoperative 26 months, anteroposterior view, and good result. (c) Postoperative 26 months, lateral view.

series, we observed a negative correlation between the degree of AVN and clinical result. In other words, a higher degree of AVN increases the degree of functional impairment of patients.

Barnes et al.^[19] reported 181 patients who sustained late segmental collapse and 53 of them had disabling (29.2%). Nonetheless, only 32 cases needed secondary procedures (17.6%). Nikolopoulos et al.^[6] reported a 39.5% AVN rate of the displaced femoral neck fractures. However, 10 of 15 cases with AVN were satisfied with clinical result and level of daily activities. In the current study, only 13 of 32 cases (40%) had AVN radiologically after a minimum follow-up period of 24 months. Eight cases had precollapse phase of AVN and all had satisfactory outcomes. However, 5 patients having collapsed AVN required salvage surgery as total hip arthroplasty (15%). All these patients gained satisfactory results for recreational activity.

Nonunion is another important complication, with incidence ranging from 4% to 33%. The main causes of nonunion are poor quality of reduction, mechanical failure in fixation and insufficient blood supply to the femoral head. Nicolopoulos et al.^[6] reported 15.8% nonunion in the displaced femoral neck fracture group. Lowell^[20] reported an overall nonunion rate of 17%, Barnes et al.^[19] of 26% and Lu-Yao et al.^[21] of 33%. In the present study, 5 of the 32 (15%) cases developed nonunion requiring salvage surgeries. We performed total hip arthroplasty after deciding they were nonunion. These patients had satisfactory clinical results after salvage surgery.

Generally, it was concluded that immediate fixation is the gold standard for femoral neck fractures in relatively young cases. In this situation, it is believed that early surgical reduction and fracture stabilization may improve femoral head blood flow leading to a decrease in AVN and union complications.^[12] Szita et al.^[22] reported the results of femoral neck fractures in elderly patients who were treated immediately. They found the rate of AVN was significantly lower (10.5%) in cases who underwent surgery within 6 hours of injury than in cases treated after 6 hours of initial trauma (20%). However, Barnes et al.^[19] reported the results of 1503 subcapital fractures of the femur in a multicenter study. They examined many factors affecting union and late segmental collapse, and claimed that there was

no evidence to suggest that delay up to 7 days before reduction and fixation adversely affected the fate of the femoral head. Holmberg et al.^[3] reported the analysis of 2418 patients admitted to 12 hospitals 6 years after the fracture. They reported finding no common trend for redisplacement, nonunion or for segmental collapse when the delay was 1 week or longer. Several factors, such as older patient age, fracture displacement, poor fixation quality, high-energy trauma, intracapsular pressure and delay in operation, have been accused for the development of AVN.^[7,12,21] However, the exact cause of AVN while bony healing is achieved is not well understood. Therefore, a prospective, randomized clinical trial involving multiple factors with large series should be more useful.

In our series, some of the cases were admitted to emergency service more than 8 hours after injury. Therefore, these cases were operated more than 8 hours after the initial trauma. We analyzed the correlation between the complications and time to operation after trauma, but were unable to determine any statistical correlation between them. Consequently, it was thought that since all these patients have the opportunity for salvage surgery at any time after trauma, internal fixation must be the first choice of intervention and must be performed as soon as possible.

In conclusion, AVN is the most obvious complication in displaced femoral neck fractures. On the other hand, many of these cases do not necessitate salvage surgery. Total hip replacement is a good option in unsatisfactory cases with AVN to facilitate their return to their previous activities.

REFERENCES

1. Strömquist B, Hansson LI, Nilsson LT, Thorngren KG. Hook-pin fixation in femoral neck fractures. A two-year follow-up study of 300 cases. *Clin Orthop Relat Res* 1987;(218):58-62.
2. Rogmark C, Carlsson A, Johnell O, Sernbo I. A prospective randomised trial of internal fixation versus arthroplasty for displaced fractures of the neck of the femur. Functional outcome for 450 patients at two years. *J Bone Joint Surg [Br]* 2002;84:183-8.
3. Holmberg S, Kalén R, Thorngren KG. Treatment and outcome of femoral neck fractures. An analysis of 2418 patients admitted from their own homes. *Clin Orthop Relat Res* 1987;(218):42-52.
4. Bhandari M, Devereaux PJ, Swiontkowski MF, Tornetta P 3rd, Obrebsky W, Koval KJ, et al. Internal fixation

- compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. *J Bone Joint Surg [Am]* 2003;85-A:1673-81.
5. Asnis SE, Wanek-Sgaglione L. Intracapsular fractures of the femoral neck. Results of cannulated screw fixation. *J Bone Joint Surg [Am]* 1994;76:1793-803.
 6. Nikolopoulos KE, Papadakis SA, Kateros KT, Themistocleous GS, Vlamis JA, Papagelopoulos PJ, et al. Long-term outcome of patients with avascular necrosis, after internal fixation of femoral neck fractures. *Injury* 2003;34:525-8.
 7. Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. *J Bone Joint Surg [Am]* 2005;87:1680-8.
 8. Garden RS. Reduction and fixation of subcapital fractures of the femur. *Orthop Clin North Am* 1974;5:683-712.
 9. Leadbetter GW. Closed reduction of fractures of the neck of the femur. *JBJS* 1938;20:108.
 10. Ficat P, Arlet J. Pre-radiologic stage of femur head osteonecrosis: diagnostic and therapeutic possibilities. [Article in French] *Rev Chir Orthop Reparatrice Appar Mot.* 1973;59:Suppl 1:26-38. [Abstract]
 11. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg [Am]* 1969;51:737-55.
 12. Jain R, Koo M, Kreder HJ, Schemitsch EH, Davey JR, Mahomed NN. Comparison of early and delayed fixation of subcapital hip fractures in patients sixty years of age or less. *J Bone Joint Surg [Am]* 2002;84-A:1605-12.
 13. Gerber C, Strehle J, Ganz R. The treatment of fractures of the femoral neck. *Clin Orthop Relat Res* 1993;(292):77-86.
 14. Swiontkowski MF, Winquist RA, Hansen ST Jr. Fractures of the femoral neck in patients between the ages of twelve and forty-nine years. *J Bone Joint Surg [Am]* 1984;66:837-46.
 15. Franzén H, Nilsson LT, Strömqvist B, Johnsson R, Herrlin K. Secondary total hip replacement after fractures of the femoral neck. *J Bone Joint Surg [Br]* 1990;72:784-7.
 16. Skinner PW, Powles D. Compression screw fixation for displaced subcapital fracture of the femur. Success or failure? *J Bone Joint Surg [Br]* 1986;68:78-82.
 17. Calandruccio RA, Anderson WE 3rd. Post-fracture avascular necrosis of the femoral head: correlation of experimental and clinical studies. *Clin Orthop Relat Res* 1980;(152):49-84.
 18. Ort PJ, LaMont J. Treatment of femoral neck fractures with a sliding compression screw and two Knowles pins. *Clin Orthop Relat Res* 1984;(190):158-62.
 19. Barnes R, Brown JT, Garden RS, Nicoll EA. Subcapital fractures of the femur. A prospective review. *J Bone Joint Surg [Br]* 1976;58:2-24.
 20. Lowell JD. Results and complications of femoral neck fractures. *Clin Orthop Relat Res* 1980;(152):162-72.
 21. Lu-Yao GL, Keller RB, Littenberg B, Wennberg JE. Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. *J Bone Joint Surg [Am]* 1994;76:15-25.
 22. Szita J, Cserhádi P, Bosch U, Manninger J, Bodzay T, Fekete K. Intracapsular femoral neck fractures: the importance of early reduction and stable osteosynthesis. *Injury* 2002;33 Suppl 3:C41-6.